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Zero Retries is a unique, quirky little highly independent, opinionated, self-published email newsletter about technological innovation in Amateur Radio, for a self-selecting niche audience, that's free (as in beer) to subscribe.

About Zero Retries

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Request To Send

Countdown to Digital Communications Conference 2022 - September 16-18, in Charlotte, North Carolina, USA (see below):
~~**10**~~ **09** weeks…
Countdown to DCC 2022 Paper submission deadline - September 1:
~~**~08**~~ **~07** weeks…

My apologies to Zero Retries readers who have been involved in Digital Voice in Amateur Radio for years, or decades. For those folks, reading this issue, and next week's issues will probably be painful as I work through my lack of knowledge about this subject.

As of this issue, Zero Retries has *350+ subscribers!* Thank you!

Update: A perfect example of "Zero Retries Interesting Moments" is that the lead article (just below) "came out of nowhere at me" on Thursday, perfectly aligned with this issue's theme. This issue was already displaying the dreaded **(!) Near email length limit** *before* the lead article. Thus this issue expanded into a two-part treatment, concluding (I hope…) with Zero Retries 0056 next week.

Summer continues to be gorgeous and comfortable here in Bellingham!

de Steve N8GNJ

CS800D PLUS Dual Band DMR and Analog Mobile Radio

DMR, D-Star, P25, NXDN, and YSF Digital Voice modes "in one radio" (?)

To not "bury the lede" of this hot news, I'm putting this article first in this issue. "Proper story order" of my exploration of the subject would place this article last.

***Really**, dear Zero Retries readers…I only learned of this radio **after** I spent most of Wednesday 2022-07-13 writing the following articles in which arrived at essentially the same conclusion as the basis of the CS800D PLUS. That is, perhaps*

the most viable approach to solving the Amateur Radio Digital Voice "Tower of Babel" was to use a basic radio with an outboard computer device such as an MMDVM (see below for an explanation) to access all Digital Voice modes. Sometimes, things just work out.

Image courtesy of Connect Systems Inc.

On 2022-06-30, on the Facebook group Connect Systems Group by Jerry Wanger, Jerry Wanger posted this note: **Look on our website for the CS800D PLUS.**

The Raison D'être of the CS800D PLUS is best summarized by these excerpts from the CS800D PLUS product page:

- *… Ability to do DMR, [FM], FUSION, DSTAR, P25 and NXDN [and possibly M17].*
- *The hardware of the CS800D PLUS is a CS800D with more memory, a GPS module and a few minor changes to the PCB. The key to some of the advanced features is the ability to tightly integrate a separate computer into this radio.*
- *The firmware will be done in stages over a period of many months. Some of the firmware will be done by the Amateur community.*
- *The external computer can be as simple as a single chip micro connected the DB15, a Raspberry Pi computer, or a standard PC.*

A link at the bottom of the product page titled Interface Between Radio and External Computer goes to a PDF titled *Future Feature of the CS800D PLUS*, which goes into detail about the planned evolution of the CS800D PLUS.

The big change from the CS800D to the CS800D PLUS is that apparently Connect Systems has been able to work with the radio manufacturer to allow access to some of the internals of the radio and selectively route signals out of, and back into the radio to and from an external computer.

*A critical difference from connecting a Digital Voice modem such as an MMDVM to a radio such as the Kenwood TM-V71A ("flat audio" / "Data Connector" analog audio) - the external input / output signals of the CS800D PLUS are **digital signals**, and thus can be processed by an external computer **as data**. (No "audio interface" required in the external unit.) That's an impressive increase in capability!*

One big advantage of this approach in the CS800D PLUS is that the microphone, speaker, controls, display, and operating parameters (transmit power, etc.) *seem to be* accessible from the radio's (modified?) firmware in this scenario. Thus for

Digital Voice modes such as M17 where the voice and other processing is performed by the external computer, the *radio's* microphone, speaker, etc. can all be used by the external computer, rather than attaching a microphone, speaker, etc. *to* the external comptuter.

Connect Systems's goal is to evolve the CS800D PLUS into a universal (I like the term *polyglot*) Digital Voice radio for Amateur Radio use. There's is even a passing mention to M17:
If you want to use a M17 vocoder, substitute the native vocoder for the M17 vocoder. It's cool that M17 is now well-enough established that it's at least a consideration as one of the future Digital Voice modes in this radio.

Clicking on the BUY NOW button, the CS800D PLUS is $429 (presumably plus shipping and sales tax). There are few radio specifications on the CS800D PLUS page, so these basic radio specifications are from the CS800D page:

- Receive frequency: 136 - 174 MHz, 400 - 512 MHz
- Transmit: 136 - 174 MHz, 400 - 470 MHz
- DMR and Analog modes [before future enhancements]
- Analog has both 12.5 and 25 KHz channels available
- Adjustable output power. Maximum power on VHF is 50 Watts, UHF is 45 Watts

I think the bigger story here, that perhaps Connect Systems has not realized, is that the CS800D PLUS might actually be an ***ideal data radio***, not "merely" a Polyglot Digital Voice Radio.

I'll be watching closely following the development of the CS800D PLUS in future issues of Zero Retries.

Amateur Radio Digital Voice - Part 1

In this context, Digital Voice (DV) is realtime digitized voice that is transmitted over radio channels as a continuous bitstream, not packetized digitized voice that is transmitted over networks.

This topic was triggered by a confluence of several elements of research about the role of Digital Voice (DV) technology in Amateur Radio:

- The article Universal Digital Voice by my ARDC colleague Bob Witte K0NR. Bob makes a case that in 2022, Amateur Radio ought to be doing better having come to some agreement on *a* Digital Voice (DV) standard instead of the multitude of non-interoperable DV implementations that we currently use.
- Another article from 2018 that I think is still relevant - Will digital voice (on HF) ever be a thing? by another ARDC colleague (and Zero Retries Pseudostaffer) Dan Romanchik KB6NU.
- My recent discovery that FreeDV is now just another supported mode of the current generation of FlexRadio systems.
- My very preliminary research into the state of progress of the M17 Project, specifically its progress to the point of "good enough to experiment with" hardware options.

*Very strong disclaimer - all of this (with the exception of the quoted sections) is it seems to **me** (Steve N8GNJ). These are my conclusions. Your personal conclusions about DV will probably vary.*

*Disclaimer 2 - I'm very deliberately **not** going to wade into the intellectual hairball of discussion and debate regarding Intellectual Property (patent) / proprietary technology issues involved in the DVSI CODEC technology that is incorporated into D-Star, DMR, P25, and YSF. My view is that issue is no different from a choice of microprocessor technology (which is also proprietary). That is, use of the DVSI CODEC is largely irrelevant to my discussion here about the fragmentation of Digital Voice standards currently in use in Amateur Radio. If you disagree with this position, see the disclaimer above.*

I think K0NR frames the basics of Digital Voice in Amateur Radio dilemma well in his article:

> FM was invented in the 1930s, which is ancient history from a technological point of view. It has served us well, but it is long past time to move to digital. Of course, we do have many handheld and mobile radios

> available that support digital voice (DV) modulation. In fact, we probably have too many digital formats to choose from, all incompatible, which has fragmented the market. The three dominant digital voice modes are D-STAR (first out of the chute), DMR (a commercial standard) and Fusion (Yaesu's C4FM offering). I think these all have their advantages and disadvantages which attract various people to support one or more of them. However, none of them is dominant and universal, like FM. It is interesting that virtually all DV radios on VHF/UHF include analog FM because it is The Utility Mode, the fallback modulation that keeps us all compatible.

Again, K0NR has a good capsule description of "*Why* beyond FM?":

> How cool would it be to get on top of a summit and push the *DV Call* button and work stations on digital many miles away? The station's callsign should be embedded in the digital stream along with location data (lat/lon or grid locator) and some user-defined fields (SOTA reference or other information). This format should also have really good weak-signal performance, significantly better than FM, for when the signal-to-noise ratio is low.

To me, it's instructive that following the lead of Yaesu System Fusion (YSF) in offering YSF / FM, the newest generation of Icom's D-Star Digital Voice repeaters now offers D-Star / FM. Hytera offers a DMR / FM repeater. A fourth Digital Voice system in use in Amateur Radio is APCO-25 / Project 25 / P25, only present in Amateur Radio because of surplus public safety radios that use P25. I'll guess that there is a dual mode repeater system out there that can do P25 / FM.

There are many arguments, pro and con, for and against each of these Digital Voice systems. Space doesn't permit a rehash of those arguments here.

Thus, Amateur Radio has a "Tower of Babel". We have no standard for Digital Voice, only a fallback to FM.

Side Discussion - Multimode Digital Voice Modem (MMDVM)
Yet another disclaimer… I am very much a newbie when it comes to discussion of MMDVM. The more I researched MMDVM, the more information there was to read and understand about MMDVM. I'll be in "learning mode" about MMDVM for quite some time. A fair treatment of MMDVM's capabilities will take at least a book chapter. In this brief discussion, I'm not addressing the common usage of an MMDVM "hotspot" which serves as a radio interface between a portable radio and a network of repeaters.
A partial solution to the "Tower of Babel" of incompatible Digital Voice modes is MMDVM. There are implementations of MMDVM for users and repeaters. At its most basic, MMDVM is essentially a modem for digital voice modes - *all* of the digital voice modes. In the MMDVM documentation I saw references to AX.25, D-Star, DMR, FM, NXDN (Icom), P25, POCSAG (paging), YSF, and… M17. As I understand it, MMDVM can operate *all* of these modes, it can switch between them, and there can even be transcoders to convert one DV mode to another. But, it can only operate one DV mode at a time. Some of the hardware portions of MMDVM are listed on BrandMeister's Homebrew/MMDVM page. There is also the ZUM Radio MMDVM-Pi Board available from Ham Radio Outlet in the US.

Perhaps it's time to try to incorporate MMDVM's ability to operate all the Amateur Radio Digital Voice modes into a "polyglot" radio? Eventually we'll have powerful enough processors to enable MMDVM to automagically deal with all the Digital Voice modes, "on the fly", perhaps with a default to M17. If someone uses, for example, DMR, the MMDVM radio will instantly recognize DMR and switch to that mode for the duration of the conversation. Etc.

…

Enter M17 Project
In addition to, or perhaps as a solution to the Tower of Babel of Digital Voice modes, Amateur Radio[1] now has Open Source Codec 2 digital voice technology. One huge advantage of Codec 2 is that it's entirely software / algorithms[2] totally unencumbered by proprietary intellectual property. Thus, "as a simple matter of software", Codec 2 capability can be added to software-based radios, such has been done by FlexRadio.

For several years now, the M17 Project (M17) has been developing an ecosystem of Digital Voice (and some data) specifically for Amateur Radio VHF / UHF based on Open Source technology. M17 uses Codec 2 for digital voice. The goal of M17 (as I understand it) is to create reference designs - radio hardware, software, protocols, linking, etc. to replicate (and go beyond) the ecosystems of D-Star, DMR, P25, and YSF. OpenRTX is another project that complements M17 by developing modifications (mostly firmware) that implement M17's technology in existing radios.

M17 and OpenRTX have made good progress. My perception is that while M17 and OpenRTX hardware and software is still at the science experiment stage, it is now *possible* to use M17 on the air. Again, to cite K0NR's example, with a portable radio modified to use OpenRTX firmware, K0NR can do SOTA (Summits On the Air) and POTA (Parks on the Air) activity as usual, using M17 Digital Voice.

For those that would prefer a base station / mobile (to work K0NR in his POTA / SOTA activity) there are several options. The first is OpenRTX's modification of a TYT MD-9600 mobile radio to use OpenRTX firmware. The OpenRTX User Guide page nicely illustrates that M17 and OpenRTX are still *on the bleeding edge of usability*. Despite the TYT MD-9600 mobile radio being listed as a target unit for OpenRTX, I could not find any specific mention of how to *use* the MD-9600 once it's been modified for OpenRTX.

The second approach for a M17 base station is to make use of a radio that has a flat audio connection, such as the venerable Kenwood TM-V71A with a 6-pin MiniDIN "data" connector, and then add an M17 Module 17 hardware module. The Module 17 implements all of M17's Digital Voice, protocol, etc. and simply modulates the radio as a wideband audio stream - essentially an "M17 Modem".

While Module 17 makes M17 a bit more usable (at least for those of us that have radios with flat audio connections), the problem is that it's unobtanium. M17 has only built a handful of Module 17s, with no apparent plans to make assembled and tested units available for more widespread testing and experimentation. I've previously mentioned that Crowd Supply in Portland, Oregon has increasingly become a trusted source of radio-based projects, including a number of projects specifically for Amateur Radio. If M17 wanted to get some additional real-world feedback and at least some pilot deployments, they could work with Crowd Supply or another manufacturer to get some Module 17s into hands of people that might be willing to test M17 in real world conditions.

…

Amateur Radio Digital Voice - Part 2 will appear in Zero Retries 0056 next week - Friday 2022-07-22.

Updata

In Zero Retries 0018, I wrote about **Amateur Radio Weekly**:
… ends abruptly at Issue 235 on 2019-03-30 with no hint of why that was the last issue.
Amateur Radio Weekly has resumed publication at Issue 236 on 2022-04-30 with this note:
After a three year hiatus, ARW is back! Technically this is a soft re-launch while I wrap up a final graduate school class and get back into the swing of the hobby. (New issues may be sporadic while getting caught up.) In the meantime, I'm anxious to see what Ham Radio has been up to the past few years. I've missed putting these together and look forward to gracing your inbox with the latest that Amateur Radio has to offer!

Join the *Fun* on Amateur Radio

If you're not yet licensed as an Amateur Radio Operator, and would like to join the fun by *literally having a license to experiment with radio technology*, check out
Join the Fun on Amateur Radio for some pointers.

Closing the Channel

In its mission to highlight technological innovation in Amateur Radio, promote Amateur Radio to techies as a literal license to experiment with wireless technology, and make Amateur Radio more relevant to society in the 2020s and beyond, Zero Retries is published via email and web, and is available to anyone at no cost. Zero Retries is proud *not to participate* in the Amateur Radio Publishing Industrial Complex, which hides Amateur Radio content behind paywalls.

My ongoing ***Thanks*** to:

- Tina Stroh KD7WSF for, well, *everything!*
- Pseudostaffer Dan Romanchik KB6NU for continuing to spot, and write about "Zero Retries Interesting" items on his blog that I don't spot on my own.
- Southgate Amateur Radio News consistently surfaces "Zero Retries Interesting" stories.
- The Substack email publishing platform makes Zero Retries possible. I recommend it for publishing newsletters.

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More bits from Steve Stroh N8GNJ:

- SuperPacket blog - *Discussing new generations of Amateur Radio Data Communications - beyond Packet Radio (a precursor to Zero Retries)*
- N8GNJ blog - *Amateur Radio Station N8GNJ and the mad science experiments at N8GNJ Labs - Bellingham, Washington, USA*

Thanks for reading!
Steve Stroh N8GNJ / WRPS598 (He / Him / His)
These bits were handcrafted in beautiful Bellingham, Washington, USA
2022-07-15

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1

Codec2 was initially developed, at least in part, *for* Amateur Radio use, but being an Open Source technology, it's not *limited / restricted* to Amateur Radio.

2

Arguably, this is the case with all CODECs, including those from DVSI. As a matter of practicality for radio manufacturers, DVSI implements their digital voice software / algorithms in a chip for embedding into radios.